The emerging informationist specialty: a systematic review of the literature EC

Jocelyn A. Rankin, PhD, MLn, AHIP, FMLA; Suzanne F. Grefsheim, MEd, MSLS, FMLA; Candace C. Canto, MA, MLS

See end of article for authors' affiliations.

DOI: 10.3163/1536-5050.96.3.005

Purpose: A systematic literature review was conducted to synthesize what is known about informationists, highlight program models, and suggest areas for future research.

Methods: Articles retrieved through database searching were reviewed for relevance. Informationist case reports were identified and coded according to an attributes checklist. Data from other retained publications were synthesized under broad themes. The few research studies found were reviewed for level of evidence.

Results: Of 113 papers reviewed, the study identified 7 classic and 8 emerging informationist programs. Two major models are apparent, clinical and research, with priorities differing according to program maturity. The literature synthesis also brought together current thinking about informationist qualifications; practice roles; setting characteristics; education and training; organizational, programmatic, and service provider success factors; and challenges and barriers. Program outcomes to date are reported, and future research topics suggested. Specific findings will assist informationist program planners.

Conclusions: While the informationist concept remains in the early adopter stage, it appears that domain knowledge, continuous learning, and embedding (working in context) are essential to success. The need for librarians to transition to greater specialization and libraries to emphasize customized service was underscored. A research agenda focused on information management, dissemination, behaviors, and economics is proposed.

INTRODUCTION

It has been seven years since Davidoff and Florance [1] proposed a new professional, an informationist with responsibility for providing highly specialized information services in the clinical setting. Davidoff and Florance characterized these new professionals as knowledge workers formally trained in both the information and clinical sciences so they can retrieve, synthesize, and present medical information routinely for clinical health care teams. They called for a national program to credential these professionals and advocated for their financial support to come directly from clinical funds.

In recognition of the broad scope of information needs in health care and the variability among health care institutions, discussion of this information specialty has encouraged multiple perspectives. Model programs (Tables 1 and 2) have sprung up in health policy and public health, biomedical research, and other related domains as well in clinical settings, where an expanded concept of clinical librarianship had been developing for some time. The original term, informationist, prevails although information specialist in context (ISIC) [2] is also used to emphasize the importance of the setting in framing the informationist's role. Internationally, the label of informaticist is sometimes applied [3, 4].

The objective of this literature review is to synthesize and share the literature related to the informationist in order to assist new and developing programs in planning and setting future directions. Related objectives are to identify model programs and suggest future directions for research. Davidoff pointed out that a way to understand the state of the informationist is to apply Rogers' diffusion of innovations model [5]. Under this model, the informationist innovation still falls in the early adopter category (stage two of five), which follows immediately after the innovator category and is characterized by local applications and involvement of opinion leaders. (Stages three to five include the early majority, the late majority, and laggards [6].) As Light observed [7], given the formative nature of the specialty, this study can only be an exploratory and descriptive attempt to look broadly at what is known to date and suggest directions for further research.

The paper will:

- assess how broadly the concept has been discussed in the literature
- identify and characterize model programs
- report commonalities in various definitions and roles
- identify education and training approaches
- summarize success factors
- report challenges and barriers to implementation
- summarize reported outcomes
- provide an overview of suggested further research

BACKGROUND

The overarching rationale for the informationist profession is the growing amount of biomedical

EC Supplemental Tables 3 and 4 are available with the online version of this journal.

Highlights

- After years of emphasizing the generalist librarian, health sciences librarians must become more specialized, paralleling the health care environment in which they work.
- An embedded informationist is more likely to achieve credibility, acceptance, and sustainability than an impersonal information service provided at a distance.
- Subject expertise is essential for the informationist.
- Model informationist programs with the greatest stability are library funded.
- Because informationist programs are inherently targeted to small groups, multisite studies are necessary to achieve robust evaluation.

Implications

- A library starting an informationist program should review existing models, identify local needs, set program objectives, and then select the most appropriate approaches for its users.
- Programmatic emphasis should be placed on both technical and service excellence.
- Organizational commitment is needed for knowledge integration into practice and for the informationists' lifelong learning.

information that challenges health care practitioners to stay current. As justification for their proposal, Davidoff and Florance pointed out that this information resides in scattered formats with inconsistent indexing and accessibility and requires time, domain knowledge, retrieval, and critical appraisal skills to convey the best of it to the point of care [1]. Changes in scholarly publishing [8, 9]; inconsistent and slow translation of research into practice [10]; lack of readily available (prepackaged) syntheses of evidence [11]; pressures on physicians to practice evidence-based medicine (EBM), reduce risks, ensure patient safety, and deliver cost-effective care [12]; lack of nursing staff time [13]; and a more informed patient population [14–16] are some of the compelling reasons for an informationist in hospital settings.

The literature is filled with justification for this concept in other settings as well. In the United Kingdom, the National Health Service (NHS) clinical governance policy mandates routine EBM practice in general practice settings [17]. In public health emergencies, public trust requires rapid, informed responses to health threats that are often of unknown origin and that continually unfold over hours and days [18]. Researchers in the fields of molecular biology and genetics now must master new tools to manage and mine large data sets, the results of an information explosion made possible by advances in technology and large scale international collaborative research efforts [19]. Major demographic population shifts and the resulting budgetary challenges also require difficult decisions in health care policy that must be informed by accurate data and information [20].

Both the Medical Library Association (MLA) and the National Library of Medicine (NLM) have supported the idea of the informationist. Following Davidoff and Florance's editorial, the MLA Board of Directors convened a special conference at NLM to discuss the concept with library professionals, informaticians, academicians, health care practitioners, and accreditation bodies. Topics included training requirements, funding models, concept marketing, programmatic models, and evaluation strategies [21]. Subsequent MLA annual meetings featured an open forum, chapter sharing roundtables, and numerous paper presentations on the informationist [22–25]. The MLA Task Force on the Informationist Specialist in Context engaged the Eskind Biomedical Library at Vanderbilt University to investigate and report on the concept and perceptions of the informationist [26]. NLM meanwhile stepped forward with a new grant program for informationist training fellowships [27], with the first awards given in 2004.

The concept has roots in well-established library outreach practices, notably the library liaison and clinical medical librarian (CML) programs. Although Europeans have been familiar with subject specialists in libraries for centuries, widespread adoption of the academic library liaison program in the United States dates from World War II [28]. In the early 1970s, Lamb introduced the idea of a CML program to link literature with patient care by having librarians participate on hospital rounds and supply case-related information [29]. Lamb's CML programs were emulated by other similar efforts across the country and more recently internationally [30, 31]. Both the CML and liaison responsibilities are now seen as the basis for maturation into informationist roles [32, 33]. The EBM movement also stimulated libraries to take on informationist roles [34–36].

In the last twenty-five years, technology has also been a major factor driving integration of librarians into various health care settings. Matheson and Cooper's 1982 seminal report challenged health sciences centers to better position themselves to leverage new technologies. It anticipated cross-disciplinary library roles that spanned the professional boundaries of information science, technology, and the health sciences [37]. Picking up this thread, Davidoff and Florance suggested the informationist serve as a critical intermediary with developing technology such as gathering meta-information about clinical questions [1]. Looking forward to 2015, Lindberg and Humphreys's futuristic vision of medical libraries proposed a marked increase in electronic information but also more in-context work by librarians ''to improve quality, to reduce the risks associated with inefficient or incomplete retrieval of the available evidence, and to do community outreach'' [38].

Table 1
Classic informationist models: published reports that contained all defining attributes of an informationst program

Author, year [reference]	Article type	Program attributes	Setting	Description	Funding	Outcomes
Bioscience						
Chattopadhyay, 2006 [111]	Case report	A, B, C, D, E, F, G	University of Pittsburgh, Pittsburgh PA	Molecular biology/genetics expert with formal training in information science provides workshops, consultations, web portal, specialized licensed resources, presentations for faculty and scientific meetings, coauthoring, and co-instruction.	Institution	Expanding role led to adding staff and resources.
Minie, 2006 [61]; Yarfitz, 2000 [19]; Florance, 2002 [70]	Case report	A, B, C, D, E, F, G	University of Washington, Seattle, WA	Bioinformatics service includes bioinformatics classes, consultations, software support, and advanced tool development. By 2005, a team approach enabled support of university researchers, regional business, and not-for-profit community.	Shared grant/ institution	85% of questions required specialized subject knowledge. Class evaluations and web surveys point to customer satisfaction.
Clinical						
Whitmore [74]	Case report	A, B, C, D, E, F, G	US National Institutes of Health, Bethesda, MD	14 informationists work with 40+ scientific groups. Roles include expert searching and literature syntheses, participation in team research projects, and specialized activities such as gene data analysis.	Institution	Evaluation (surveys and key informant interviews) shows strong acceptance and uptake.
Florance, 2002 [70]; Giuse, 2005 [12]	Case reports	A, B, C, D, E, F	Vanderbilt University, Nashville, TN	Clinical Informatics Consult Service (CICS) informationists answer questions on rounds, with evidence-based medicine (EBM) literature synthesis. They also train health care team to manage routine queries, provide consultation, engage in continuous learning. They support outpatient care through medical record messaging button for "evidence consult."	Institution	Formal evaluation underway; authors believe CICS saves clinician time. Combining literature synthesis with knowledge tools in the practice workflow may be more effective than either one alone.
Greenhalgh, 2002 [3]; Martin, 2001 [77]; Swinglehurst, 2005 [15]	Case report	A, B, D, F A, B, C, D, F	Imperial College London and Basildon, Essex, UK	Study compared 2 primary care informaticist projects, 1 in an academic department, the second in a general practice (GP) setting supported by GP informaticists with formal EBM/search training. The academic program emphasized rigorous research guidelines whereas the practice setting was more service oriented. Both tried to promote questioning and offered training.	Grant	Study demonstrated that evaluation of an informaticist service should include both technical and service dimensions.
Sladek, 2004 [109]	Case report	A, B, C, D	Repatriation General Hospital, Daw Park, Australia	Pilot project of informationist program in acute tertiary care hospital. The informationist attended rounds and clinical meetings for 23 weeks, provided literature searches per a search protocol, and developed evidence summaries.	Grant	Pilot study showed that doctors will use an informationist service. The service contributed/probably contributed to their professional development, and influenced clinical outcomes.
Education and Research						
McKibbon, 2004 [34]	Case report	A, B, C, D, F, G	McMaster University, ON, Canada	2 librarians on informatics research team perform administrative and writing responsibilities for evidence-based practice journals, tutoring and preceptoring, training, conducting systematic reviews, and critical appraisal.	Institution	Librarians showed personal growth and earned clinical faculty appointment.

See Figure 1 for program attribute definitions.

METHODS

The informationist concept has been discussed through electronic mailing lists, blogs, conference presentations, newsletters, and the published literature. This review was limited to English-language literature published primarily from 2000 to 2006. Newsletters and unpublished works were excluded with the exception of grant abstracts [39–44]. The start year of 2000 corresponds with publication of the Davidoff and Florance article.

Databases were searched in both the biomedical and library literature as follows: CINAHL; Computer Retrieval of Information on Scientific Programs (CRISP); EMBASE; ERIC; Google Scholar; Library, Information Science & Technology Abstracts (LISTA); Library Literature; PubMed; Scopus; and Web of Knowledge. Search terms were "informationist," "information specialist," "ISIC," and "informaticist." Additionally, article bibliographies were hand-searched and a citation search of Davidoff and Florance's article was performed in Web of Science.

Basic inclusion criteria therefore were English-language publications dating from 2000 using informationist terms. The de-duplicated results set meeting these basic criteria numbered 198 publications. Papers were further excluded if they did not offer a perspective or program description related to the informationist. The retained publications (n=113) included case reports, grant abstracts, editorials,

Table 2
Emerging and variant informationist models: published reports that contain some but not all defining attributes of an informationist program

Author, year [reference]	Article type	Setting	Program components	Funding	Outcomes
Verhoeven, 2004 [100]	Case report	University of Groningen, The Netherlands	A GP informationist trained in EBM and medical libraries provided an evidence-based service. All project participants first received training in framing EBM questions. During the project, 61 questions were answered from 26 GPs.	Grant/ institution	The majority of answers had an effect on GPs; half had an effect on patients. The time commitment was greater than anticipated.
Bioscience					
Lyon, 2006 [60]	Case reports	Harvard University, University of Florida, University of Minnesota, Vanderbilt University	4 bioinformatics services developed in the context and needs of their institutions are described with emphasis on collaborations and partnerships.	Institution	While programs differ, partnerships can be categorized as knowledge management, instruction, and e-resource support.
Oliver, 2005 [33]	Case report	John Hopkins University, Baltimore, MD	Project developed lab software for collecting and analyzing lab data. The bioscience informationist identifies literature needs and assists with technical development of information resource discovery software.	Grant	Evaluation is planned.
Rein, 2006 [62]	Case report	Purdue University, West Lafayette, IN	Bioinformationist performs needs assessment and environmental scan and develops instructional programs. Reference, consultations, new technologies, and services are planned.	Institution	Faculty and students from 31 departments participated in bioinformatics instruction event.
Tennant, 2005 [89]; Lyon, 2006 [60]	Case report	University of Florida, Gainesville, FL	Bioinformatics information specialist for genetics research and graduate education provides classes, course-integrated instruction, traditional collection development and reference, website support, information summaries and synthesis, and in-depth consultations. Promotes service through multiple channels.	Institution	Program has received positive informal feedback, led to increased participation in classes and requests for services, and led to support for similar program for nursing.
Education and research					
Detlefsen, 2004 [54]	Case report	University of Pittsburgh, Pittsburgh, PA	Informationist with a clinical mental health research center team provides information dissemination for team and consumers, reference services, teaching, lead in systematic review (pending grant funding), and is a member of the Executive Committee.	Grant	Professional growth noted.
Public health					
Rook, 2001 [124]	Case report	St. George's Hospital Medical School London, UK	Information specialist program for public health (PH) postgraduate trainees evolved from liaison into team member providing consultations, evidence-based PH training, promotion of e-resources, establishment of e-network, and participation in PH curriculum.	Fee	Evaluation includes quantitative and focus groups. Response has been positive.
Swain, 2004 [18]	Case report	US Centers for Disease Control and Prevention, Atlanta, GA	As a team member in week-long Federal Emergency Management Agency (FEMA) bioterrorism exercise, the informationist provided information services and field-tested an information tool for investigative teams.	Institution	Both the librarian role and information tool were rated highly in post-exercise evaluations.

letters to the editor, commentaries, literature reviews, and research studies. The retained publications formed the basis of the literature review.

Prior to coding case reports, the three authors identified four essential program attributes and three secondary attributes (Figure 1) of an informationist service based on their reading and understanding of the literature. The case reports were then coded by these attributes. To increase the reliability of coding, the papers were coded independently by the authors, followed by a discussion to achieve consensus. All cases with defining attributes were further divided by customer group (Tables 1 and 2).

All 113 articles were analyzed for content related to definitions of the informationist, education and training requirements, success factors, challenges and barriers, outcomes, and areas for further research. Articles that described training programs for informationists are listed in Table 3 (online), while those that addressed the informationist concept in a more general manner are in Table 4 (online).*

Due to the variation in methods and the preponderance of opinion papers, it was not possible to do a meta-analysis. However, the 11 studies among the full set that reported research findings were selected for in-depth review using the Critical Skills Training in Appraisal for Librarians (CriSTAL) appraisal tool [45]. Excluding grant abstracts (n=6), 107 articles underwent a literature analysis.

* Three references [15, 60, 79] appear twice in one or more tables and one reference [70] appears three times in 2 tables for a total of 118 citations on the 4 tables.

Figure 1
Informationists' characteristics

Defining attributes
A. *Formal training in both information science and a subject domain expertise:* Expertise is derived from a combination of education and practical experience to ensure in-depth subject knowledge in both disciplines that is more extensive than that acquired through on-the-job training.
B. *Deep understanding of work culture:* Examples include working knowledge of clinical processes and research methods.
C. *In-context work as a team member and/or expert consultant:* Work is integrated into the practice environment and emphasizes team activities, for example, as part of the clinical team or expert consultant to bioinformatics or health policy groups.
D. *Critical appraisal and literature synthesis and/or complex bioscience data analysis*
Additional attributes (context-driven)
E. *Technology, knowledge management, content integration expert:* Examples extend from identification of and assistance with technology solutions to improve workflow to advanced informatics expertise for system design and development.
F. *Trainer*, *co-teacher*, *evidence educator:* Educational roles range from formal instruction of faculty and students to individual point-of-need tutoring of team members to incorporate evidence.
G. *Other team roles:* Examples are participation in research projects, manuscript preparation, coauthoring, grant writing, facilitation of collaborations on and off campus, work on institutional committees, and more traditional roles with current awareness or identifying of new tools and resources.

RESULTS

Literature analysis

The informationist discussion has occurred largely in the library literature, with the majority of the published articles (61%, 65/107) appearing in library journals. A relatively small number of these (7%, 8/107) appeared in the informatics literature. The remainder appeared in the health care literature, with 2 in influential Institute of Medicine reports urging new levels of quality in health care and in the education of health professionals. Papers appearing in international publications accounted for 34% (36/107) of the total. Interest in the concept over time, as reflected by the literature, has remained modest but steady: 4 articles in 2000, 12 articles in 2001, 16 articles in 2002, 8 articles in 2003, 24 articles in 2004, 20 articles in 2005, and 21 articles in 2006.

Model programs

The literature review focused first on identifying program models. Seven case reports demonstrated all four defining program attributes—that is, formal training in both information science and a relevant subject, understanding of the work culture, in-context work setting, and responsibilities for subject content such as through critical appraisal or work with complex datasets—and were coded as ''classic informationist models'' (Table 1). Eight case reports demonstrated one to three of the four essential program attributes and were coded as ''emergent and variant informationist models'' (Table 2). Both model types, classic and emergent, varied in the extent of additional optional context-driven attributes relating to technology, training, and other team roles.

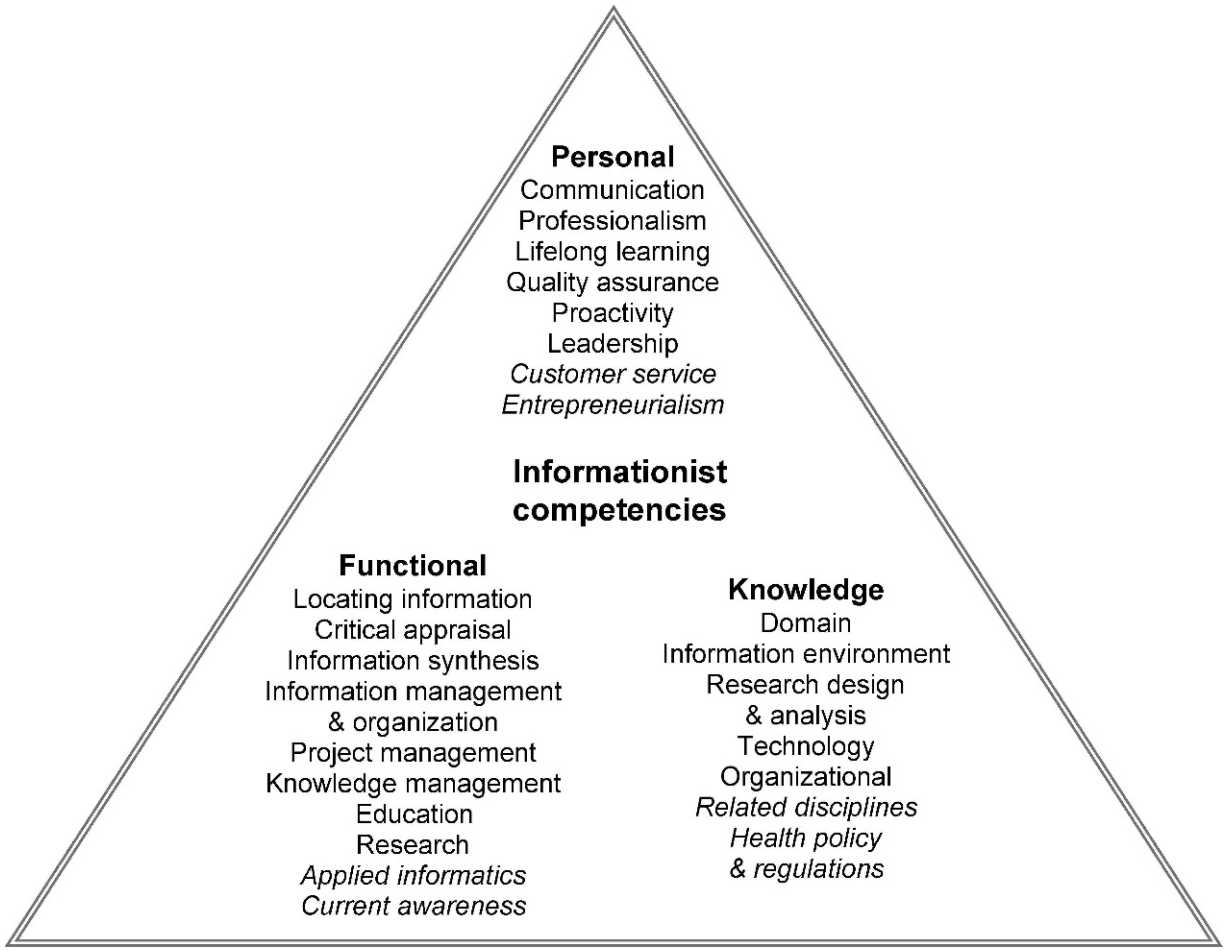
There was high agreement in the independent coding (89%) for programs that demonstrated the 4 essential attributes and were therefore deemed classic programs (Table 1). Coding consistency fell to 65% for the remaining 17 papers that were reviewed for possible inclusion in Table 2 as informationist program reports. This reflected the wide range in detail and clarity in these descriptive reports.

Definition

The definition of the informationist continues to be refined. Some have cautioned that too diffuse an interpretation might result in losing the ability to differentiate the specialty from other nontraditional library roles [26, 46, 47]. The following are the qualifications, roles, and work setting characteristics as reported in the literature:

- *Qualifications* [1, 21, 26, 46, 48–51]:
  - graduate preparation in either a subject discipline and/or the information sciences with in-depth knowledge of both the domains
  - practical skills in framing questions; retrieving, appraising, and synthesizing literature; and managing and presenting information
  - applied knowledge of the research process
  - informatics training and applied technical skills
  - skills for teamwork, communication, multidisciplinary thinking, and proactive customer service along with institutional knowledge
- *Practice roles* [1, 20, 38, 47–69]:
  - recognized member of health care or research team
  - seamless integrator of appropriate evidence and tools into health care or research workflow
  - critical questioner, appraiser, and synthesizer of the literature with direct responsibility for quality of results
  - evidence educator for team and/or students
  - technology expert for team
  - resource discoverer and evaluator for discipline-specific information products
  - collaborator or coauthor in team research
  - knowledge translator and facilitator of knowledge sharing
  - information manager
  - partner in ongoing team information needs assessment
  - facilitator of collaborations in the institution and externally
- *Practice setting* [10, 46, 48, 51, 53, 70]:
  - is located outside the library
  - shapes the type of information, technical and service components, and dissemination methods
  - may house and/or fund position

Figure 2
Informationist competencies as adapted from Giuse model [26] with suggested additions noted in italics



Education and training

The discussion of the formal educational preparation and training for the informationist specialty is also ongoing. Responses to Davidoff and Florance's vision [1] of a national program with a standardized curriculum and formal credentialing have been wide ranging. Some have advocated even more academic rigor and professional licensing [53, 56], whereas others have suggested on-the-job training supplemented by self-directed learning, continuing education, and other experiential activities [49, 71]. While many informationist programs use librarians, Swinglehurst believes the general practitioner is best suited to fill this role in clinical medicine [72]. Clearly, the multidisciplinary nature of the informationist allows a variety of pathways into the specialty. To illustrate this point, Detlefsen identifies several possible combinations of educational and experiential backgrounds in library science, informatics, biomedicine, and science that could lead to an informationist career [50].

Giuse proposes a comprehensive training framework for the informationist with competencies grouped according to knowledge, functional abilities, and personal skills [26]. The literature reinforces this framework although there are some additional suggestions and emphases. Deep understanding of the biomedical literature is fundamental to information science, from how the literature is structured to how it serves as the basis for new ideas [73]. In domain knowledge, in addition to formal education requirements, related discipline knowledge is considered important in areas ranging from biostatistics, genetics, epidemiology, and health care economics to ethics and adult learning [1, 56, 74]. Understanding of the information environment includes knowledge of health policy issues and regulations such as privacy and confidentiality (e.g., the Health Information Portability and Accountability Act [HIPAA]) and the internal review board (IRB) [38, 54]. In programs emphasizing informatics, understanding of the design and evaluation of systems, applied informatics and technology skills, and ability to function in a highly technical environment are necessary [50, 75, 76]. Among personal competencies, a sense of customer service was valued [77] (Figure 2).

Formal training models are emerging largely through multiyear NLM-funded fellowships at various universities [39–44, 78]. At least one graduate

program in information science and another in informatics offer relevant informationist training opportunities [76, 79]. Continuing education programs target specific skill sets such as bioinformatics and critical appraisal [68, 80]. Vanderbilt University provides its own formal staff development program [81, 82] (Table 3 online).

Success factors

Reports of informationist services suggested various enabling factors that contribute to the success and/or sustainability of the service. These factors have been categorized by how the service itself is constructed and delivered and the providers' skills and attributes. Not all appeared in every success story and some may be codependent.

- *Organizational factors* [46, 51, 52, 82–86]:
  - support by a champion
  - formal priority on the service
  - resource availability (technology, electronic information resources, staff)
  - systemic strategy to integrate knowledge or evidence into practice and into the institution's information systems
  - collaborative, multidisciplinary team environment
  - support of culture with commitment to informationists' lifelong learning
- *Programmatic characteristics* [15, 19, 56, 62, 77, 84, 86–88]:
  - is based on initial and ongoing needs assessments
  - is designed and implemented to fit the work environment
  - places emphasis on both technical quality and service dimension
  - includes formal and informal training of health care or research team to inculcate framing of questions, use of evidence, and critical appraisal
  - is characterized by fast turnaround, high-quality, ''plain English,'' case-specific answers with statistical information
  - represents consistent sustained effort
  - achieves program visibility and effective marketing
  - maintains built-in feedback loop
- *Service provider characteristics* [12, 15, 19, 26, 57, 62, 70, 86, 89]:
  - solid subject background with ability to understand and function in domain
  - credible critical appraisal and searching skills
  - interpersonal skills to enable full integration into team, trust relationships, and contributions to outcomes
  - understanding of and sensitivity to organizational and discipline cultures
  - professionalism, personal motivation, enthusiasm, and personal service orientation

Challenges and barriers

Obstacles to overcome prior to widespread adoption of the informationist service relate to the workforce itself as well as to the social and organizational environments in which the informationist practices.

- *Workforce issues* [21, 26, 48, 52, 58, 63, 76, 78, 90–98]:
  - lack of qualified candidates
  - need to increase workforce size and accelerate recruitment
  - need for multiple formal training programs to produce more qualified workers
  - need for better definition of core competencies
  - need for salaries to match expected educational levels
  - lack of consensus on credentialing strategy
  - need to address patient confidentiality and information practice liability issues
- *Social barriers* [10, 14, 63, 69, 84, 88, 90, 94, 96, 97, 99, 100]:
  - resistance to change
  - lack of interest by physicians and researchers
  - physician or researcher confidence in own information retrieval skills
  - general resistance to EBM, which does not always have answers and/or is perceived as cookbook approach
  - consults among peers perceived as quicker and easier
  - hierarchy of health care team and team acceptance
  - ambivalence among librarians about accepting responsibility for their practice outcomes
  - cultural differences between informationists and other library staff or librarians
- *Organizational and system issues* [10, 14, 21, 58, 63, 69, 84, 85, 88, 90, 91, 94, 96–101]:
  - retraining of existing health care workforce in routine use of point-of-need information
  - secure funding—inclusion in grants, research studies, and insurance reimbursement
  - required documentation of information used in patient care
  - incentives for information seeking in practice environments
  - scalability and sustainability
  - substantial time commitment
  - systematic prioritization of and methods for delivery of research to the point of need
  - shifting focus of libraries to more in-context practice
  - assured access to high-quality knowledge-based resources, manpower, and computers, of particular concern globally
  - need to demonstrate compelling outcomes and cost benefit
- *Opposing opinions about the need for and merits of informationists* [10, 14, 94, 102–108]:
  - EBM questioning is critical to patient care and should be mastered by physicians
  - physicians' skills with the literature will decline if informationists assume this role
  - knowledge management is integral to health care decision making and should not be separated
  - clinical medical librarians and drug information pharmacists already provide this service

– patients prefer their primary care providers as their advisors on Internet health information
– health care providers are skeptical of librarians' ability to frame questions and critically appraise literature
– librarians should focus on identification of information resources, improved presentation of information, and development of tools to bring evidence to the bedside, whereas clinical knowledge and interpretive skills belong with the medical profession

Outcomes

Of the eleven papers that presented research findings [3, 18, 19, 57, 61, 62, 94, 100, 109–111] and thus were selected for in-depth review using the CriSTAL appraisal tool [43], five were found to contribute evidence to advance understanding and evaluation of informationist programs [3, 19, 94, 109, 110]. Highlights from these studies follow.

■ *Planning and evaluation:*
– An Australian feasibility and pilot study provides a replicable method for assessing user requirements and measuring preliminary program outcomes [94, 109].
– Needs assessments identify appropriate services for any group: Basic elements of a bioinformatics informationist program appear to be training, consultations, and providing access to specialized resources [19].
– A comprehensive comparative study of two very different informaticist programs results in identifying six common program elements: aims and objectives, the informaticists's role, the process for establishing local connections, programmatic self-perception, types of questions and questioning behaviors, evaluation approaches, and models of change [3].
– To address both the technical and service aspects, evaluation must be holistic, contain a large sample, and examine a program where high-quality information responses are fully disseminated into the practice or workplace. Multiple methods help to more fully assess outcomes [3].

■ *Program components:*
– Informationist programs include both a technical quality and a service dimension, both of which are equally important [3].
– Librarian informationists can effectively perform critical appraisal if trained in the domain and equipped with EBM skills [110].
– The informationists' subject specialization is needed to answer the large majority of questions in a bioinformatics program [9]; domain knowledge is also essential in clinical informationist programs [3].
– Personalized local information interventions (as compared with answers provided from a distance) appear to achieve credibility, acceptance, and sustainability for informaticist programs [3].
– Embedded positioning encourages questioning and use of service [3, 109].

Aside from the five case reports that provide evidence for their outcomes, the program effects and/or outcomes reported by other papers in this literature review are largely anecdotal. These outcomes include informationists filling information needs more efficiently and thus saving health care practitioners' time; providing information that leads to change in patient management; identifying information resources and viewpoints not usually sought; and promoting discussion, providing reassurance, delivering evidence at the point of need when it would not otherwise have been reviewed, and enabling new knowledge or learning. Program growth is also noted as an indicator of positive program outcome as is professional growth of librarian informationists. Synthesis and appraisal, not searching, requires a significant time commitment from an informationist. Redundancy in clinical questions suggests efficiency can be gained by a tracking database. These outcomes require additional research before they can be reported with certainty.

Research questions

Given the paucity of research findings about informationists, there are many areas needing study. The literature suggested the following broad topics and specific questions:

■ *Information management and dissemination* [1, 4, 10, 12, 21, 26, 32, 52, 76, 83, 104, 112–121]:
– How can informationists improve knowledge translation?
– What kinds of information contribute to avoiding errors, shortening length of stay, and delivering better outcomes?
– What meta-information can be discovered?
– Which technologies facilitate the work of informationists? Which informationist tasks can be performed by technology?
– What range and structure of informationist services are most effective?
– What are the core competencies of an informationist?
– How does the informationist compare with other methods to increase access to evidence?

■ *Information behaviors* [3, 15, 21, 32, 69, 83, 109, 116, 122]:
– What factors promote questioning and use of the best knowledge?
– What processes facilitate use of evidence?
– What contextual factors enable implementation of the service?
– What are the developmental aspects of the informationist's role and team dynamics over time?
– How does the informationist affect group information-seeking behaviors and/or team outcomes, including through technical expertise and/or the service aspect?

■ *Information economics* [4, 21, 26, 46, 53, 63, 64, 70, 121]:
– Do informationists improve quality of care?

- Do informationists result in health care that is more efficient and more cost effective or that protects against and/or reduces error?
- Do informationists reduce length of stay, readmissions, morbidity, and mortality?
- Do informationists save time for the health care team?
- Do informationists increase patient satisfaction?
- Do informationists improve researcher productivity?

DISCUSSION

What is apparent from this review is that uptake of the informationist concept has been relatively broad, if not deep. Initially seen as a role in a clinical or hospital setting, informationist programs are emerging throughout the biomedical and health care enterprise, including public health. Specialization, a fact of life for researchers and practitioners in this age of ever-expanding knowledge, appears to be an appropriate response for the library profession as well. However, as this review demonstrated, not all clinical or bioscience information services described as informationist can be classified as informationist programs, as they do not meet all four of the defining criteria.

If, as Davidoff and Florance recommended [1], a standard qualifying curriculum and/or specialty credentialing is adopted, who is an informationist will be clear. Meanwhile, multiple models are being tested and refined. A common thread is the informationist's collaborative role and the convergence of domain and information science expertise. Both are required to effectively qualify the informationist as the broker between the information need and the plethora of information resources. As in-context information workers, however, it is ultimately the environment in which the informationist works that defines the precise role.

To date, there is no evidence to indicate a preferred set of knowledge prerequisites or best-practices training. Nonetheless, training is expected to include a variety of experiences from formal educational programs, experiential immersions, and practica in research and clinical processes. The general consensus is that both domain and information science knowledge are essential, reinforced with vigorous continuing education to maintain both competencies.

As has been shown in studies of the innovation process, several divergent but comparable concepts tend to emerge [123]. Two major informationist models are apparent, each demonstrating differing priorities as the program matures. Giuse proposed an informationist maturity model in which the program progresses through five stages: baseline, preliminary outreach, formalized service, established service, and iterative optimizing [26]. This review shows that, within these five stages, the maturation steps of the two major informationist models found in the literature are actually quite different. The successful clinical informationist begins by emphasizing the service dimension, establishing a team role, and making opportunities to deliver credible information. As the informationist's role on the clinical team matures, support for more of the team's technical or informatics information needs is added. Conversely, the bioinformatics informationist begins with a strong technical focus and with maturity offers a more personal service.

Both the informationist role and program success factors are closely tied to the institutional culture. Nonetheless, organizational commitment, needs assessments, programmatic technical excellence, and proactive service are recurring themes. The social and organizational barriers facing an informationist program reflect both the complexity of the health care environment and the rapidly changing information world.

Underpinning many of the issues is the question of funding. The grant-funded informationist models examined in this study benefited from external support to jumpstart their programs but all were time-bound; those with a combination of institutional and grant support appeared focused on adapting to secure future funding; those institutionally supported, largely by library budgets, were most stable. While Davidoff and Florance [1] advocated for support by clinical funds, forward-thinking libraries are looking to the informationist model as a new way of working and are reprioritizing toward more in-context services.

Next steps for research include more studies of classic and emerging informationist models and systematic multisite studies. By their very nature, informationist programs reach relatively small groups; therefore, to achieve adequate sample size, multisite studies are essential. Carefully controlled studies will measure baselines, develop value measures, examine short- and long-term effects, and assess whether or not issues would have been handled differently without the informationist.

STUDY LIMITATIONS

Although intended to be a comprehensive review of the state of the informationist, the considerable amount of electronic mailing lists and blog discussions, as well as unpublished papers, were not included in the scope of this study. Additionally, the focus of this review was on English-language, thus omitting several papers in other languages. Another limitation was the search terminology, particularly ''informaticist,'' which has various meanings outside the United States. This review's results also were limited by the variability among the case reports. It was often not possible to systematically identify informationist program elements and, in some cases, to discern which were actually operational and which were in planning.

CONCLUSION

This paper has attempted to coalesce ideas about what an informationist is, highlighting program roles

and models; to identify success factors and barriers to assist other early adopters with program planning; and to bring together suggestions for research needed to demonstrate value. Because innovations are tied to social change, their adoption requires effort. Factors determining the rate of adoption are the perceived advantage over previous ways of doing work; compatibility with existing values and past experiences; lack of complexity in meaning; ability to be tried out on a limited basis; and observability, that is, visibility to others [6]. While the informationist concept remains in the early adopter stage, it has the advantage of building on existing traditions, that of the CML and liaison librarian. Also, several strong programmatic models are operational and visible to the community. The informationist concept is challenged by a general lack of understanding, even within the profession, of what differentiates it from other library roles.

To date, little solid evidence has been published relating to the effectiveness of existing informationist programs or justifying new ones. Individual and widely varying case reports make generalization difficult. The informationist's value remains to be demonstrated and measured systematically across multiple settings. A research agenda that focuses on information management, information dissemination, information behaviors, and information economics is essential for the concept to reach maturity.

Neither informationist programs nor informationists are going to look alike. This is the ultimate customization of service.

REFERENCES

1. Davidoff F, Florance V. The informationist: a new health profession? Ann Intern Med. 2000 Jun 20;132(12):996–8.
2. Funk CJ. MLA Board highlights: winter 2003. MLA News. 2003 Apr;(355):1,22.
3. Greenhalgh T, Hughes J, Humphrey C, Rogers S, Swinglehurst D, Martin P. A comparative case study of two models of a clinical informaticist service. BMJ. 2002 Mar 2;324(7336):524–9.
4. Swinglehurst DA, Pierce M, Fuller JC. A clinical informaticist to support primary care decision making. Qual Health Care. 2001 Dec;10(4):245–9.
5. Davidoff F. Innovations and diffusion: the informationist program [Internet]. MLA Informationist Conference: Bethesda, MD; 4–5 Apr 2002 [cited 31 Oct 2007]. <http://www.mlanet.org/research/informationist/pdf/davidoff.pdf>.
6. Rogers EM. Diffusion of innovations. 5th ed. New York, NY: Free Press; 2003.
7. Light RJ. Summing up: the science of reviewing research. Cambridge, MA: Harvard; 1984.
8. Thibodeau PL, Funk CJ. Quality information for improved health. PLoS Biol. 2004 Feb;2(2):171–2,E48.
9. Shipman JP. Why emerging roles for health sciences librarians? Ref Serv Rev. 2004;32(1):9–12.
10. Cunningham DJ, Kronenfeld MR. The informationist: a debate. J Hosp Libr. 2004 Mar;4(1):1–15.
11. Ely JW, Osheroff JA, Ebell MH, Chambliss ML, Vinson DC, Stevermer JJ, Pifer EA. Obstacles to answering doctors' questions about patient care with evidence: qualitative study. BMJ. 2002 Mar 23;324(7339):710.
12. Giuse NB, Koonce TY, Jerome RN, Cahall M, Sathe NA, Williams A. Evolution of a mature clinical informationist model. J Am Med Inform Assoc. 2005 May–Jun;12(3):249–55.
13. McKnight M. The information seeking of on-duty critical care nurses: evidence from participant observation and in-context interviews. J Med Libr Assoc. 2006 Apr;94(2):145–51.
14. Masys DR. Effects of current and future information technologies on the health care workforce. Health Aff (Millwood). 2002 Sep–Oct;21(5):33–41.
15. Swinglehurst DA. Information needs of United Kingdom primary care clinicians. Health Info Libr J. 2005 Sep;22(3):196–204.
16. Woolf SH, Chan EC, Harris R, Sheridan SL, Braddock CH, Kaplan RM, Krist A, O'Connor AM, Tunis S. Promoting informed choice: transforming health care to dispense knowledge for decision making. Ann Intern Med. 2005 Aug 16;143(4):293–300.
17. Ward LM, Honeybourne CJ, Harrison JA. A clinical librarian can support clinical governance. Br J Clin Gov. 2001;6(4):248–51.
18. Swain R, Oliver KB, Rankin JA, Bonander J, Loonsk JW. Bioterrorism alert: reference and literature support for the CDC Director's Emergency Operations Center (DEOC) and investigative field teams. Ref Serv Rev. 2004;32(1):74–82.
19. Yarfitz S, Ketchell DS. A library-based bioinformatics services program. Bull Med Libr Assoc. 2000 Jan;88(1):36–48.
20. Droese P, Peterson N. Utilization of the medical librarian in a state Medicaid program to provide information services geared to health policy and health disparities. J Med Libr Assoc. 2006 Apr;94(2):174–9.
21. Shipman JP, Cunningham DJ, Holst R, Watson LA. The informationist conference: report. J Med Libr Assoc. 2002 Oct;90(4):458–64.
22. Fulda PO, Satterthwaite RK, eds. Proceedings, 104th Annual Meeting Medical Library Association, Inc.; Washington, DC; May 21–26, 2004. J Med Libr Assoc. 2005 Jan;93(1):143–88.
23. Fulda PO, Satterthwaite RK, eds. Proceedings, 105th Annual Meeting Medical Library Association, Inc.; San Antonio, Texas; May 14–19, 2005. J Med Libr Assoc. 2006 Jan;94(1):E1–34.
24. Fulda PO, Satterthwaite RK, eds. Proceedings, 103rd Annual Meeting Medical Library Association, Inc.; San Diego, California; May 2–7, 2003. J Med Libr Assoc. 2004 Jan;92(1):117–54.
25. Fulda PO, Satterthwaite RK, eds. Proceedings, 102d Annual Meeting Medical Library Association, Inc.; Dallas, Texas; May 17–23, 2002. J Med Libr Assoc. 2003 Jan;91(1):103–36.
26. Giuse NB, Sathe N, Jerome R. Task Force on the Information Specialist in Context (ISIC) final report: envisioning the information specialist in context (ISIC): a multi-center study to articulate roles and training models [Internet]. Chicago, IL: Medical Library Association; 2006 [cited 31 Oct 2007]. <http://www.mlanet.org/members/pdf/isic_final_report_feb06.pdf>.
27. National Library of Medicine. NLM individual fellowship for informationist training [Internet]. Program announcement number: PAR-06-509. Bethesda, MD: The Library; 2006 [cited 31 Oct 2007]. <http://grants.nih.gov/grants/guide/pa-files/PAR-06-509.html>.
28. Hay FJ. The subject specialist in the academic library: a review article. J Acad Libr. 1990 Mar;16(1):11–7.
29. Lamb GE. A decade of clinical librarianship. Clin Libr Q. 1982 Sep;1(1):2–4.

30. Wagner KC, Byrd GD. Evaluating the effectiveness of clinical medical librarian programs: a systematic review of the literature. J Med Libr Assoc. 2004 Jan;92(1):14–33.
31. Winning MA, Beverley CA. Clinical librarianship: a systematic review of the literature. Health Info Libr J. 2003;20(suppl 1):10–21.
32. Morley SK, Buchanan HS. Clinical medical librarians: extending library resources to the clinical setting. J Hosp Libr. 2001;1(2):15–30.
33. Oliver KB. The Johns Hopkins Welch Medical Library as base: information professionals working in library user environments. In: Library as place: rethinking roles, rethinking space [Internet]. Washington, DC: Council on Library and Information Resources; 2005 [cited 6 Nov 2007]. p. 66–75. <http://www.clir.org/pubs/reports/pub129/pub129.pdf>.
34. McKibbon KA, Bayley L. Health professional education, evidence-based health care, and health sciences librarians. Ref Serv Rev. 2004;32(1):50–3.
35. Ivkovic A. Evidence-based medicine available in everyday clinical practice—role of librarian and information specialist. Arch Oncol. 2006 Apr;14(suppl 1):95–6.
36. Knight T, Brice A. Librarians, surgeons, and knowledge. Surg Clin North Am. 2006 Feb;86(1):71–90.
37. Matheson NW, Cooper JA. Academic information in the academic health sciences center. roles for the library in information management. J Med Educ. 1982 Oct;57(10 pt 2):1–93.
38. Lindberg DA, Humphreys BL. 2015—the future of medical libraries. N Engl J Med. 2005 Mar 17;352(11):1067–70.
39. Fitz-Randolph ME. Information retrieval in the injury research literature. In: CRISP [Internet]. Bethesda, MD: National Institutes of Health; 2006 (grant number 5F37LM008607-02) [cited 31 Oct 2007]. <http://crisp.cit.nih.gov/crisp/CRISP_LIB.getdoc?textkey=7005445&p_grant_num=5F37LM00860702&p_query=&ticket=43568798&p_audit_session_id=257966278&p_keywords=informationist>.
40. Leisey MR. Medical social work informationist. In: CRISP [Internet]. Bethesda, MD: National Institutes of Health; 2005 (grant number 1F37LM008727-01) [cited 31 Oct 2007]. <http://crisp.cit.nih.gov/crisp/CRISP_LIB.getdoc?textkey=7168007&p_grant_num=5F37LM00872702&p_query=(informationist)&ticket=43568517&p_audit_session_id=257963251&p_audit_score=35&p_audit_numfound=1&p_keywords=informationist>.
41. Mayman GG. Public health informationist training at PHISA. In: CRISP [Internet]. Bethesda, MD: National Institutes of Health; 2006 (grant number 5F37LM008472-02) [cited 31 Oct 2007]. <http://crisp.cit.nih.gov/crisp/CRISP_LIB.getdoc?textkey=7014061&p_grant_num=5F37LM00847202&p_query=&ticket=43568798&p_audit_session_id=257966278&p_keywords=informationist>.
42. McClelland MK. Grid computing aids biomedical research at NCCU. In: CRISP [Internet]. Bethesda, MD: National Institutes of Health; 2005 (grant number 1F38LM008882-01) [cited 7 Nov 2007]. <http://crisp.cit.nih.gov/crisp/CRISP_LIB.getdoc?textkey=6997512&p_grant_num=1F38LM00888201&p_query=&ticket=49365567&p_audit_session_id=275127807&p_keywords=informationist>.
43. Swain R. Public health informationist training. In: CRISP [Internet]. Bethesda, MD: National Institutes of Health; 2006 (grant number 5F37LM008608-02) [cited 31 Oct 2007]. <http://crisp.cit.nih.gov/crisp/CRISP_LIB.getdoc?textkey=7014045&p_grant_num=5F37LM00860802&p_query=&ticket=43568798&p_audit_session_id=257966278&p_keywords=informationist>.
44. Varner D. Preparing for a career as a clinical informationist. In: CRISP [Internet]. Bethesda, MD: National Institutes of Health; 2006 (grant number 5F38LM008610-02) [cited 31 Oct 2007]. <http://crisp.cit.nih.gov/crisp/CRISP_LIB.getdoc?textkey=7013187&p_grant_num=5F38LM00861002&p_query=&ticket=43568798&p_audit_session_id=257966278&p_keywords=informationist>.
45. Booth A, Brice A. Appraising the evidence. In: Booth A, Brice A, eds. Evidence-based practice for information professionals: a handbook. London, UK: Facet Publishing; 2004. p. 104–18.
46. Plutchak TS. The informationist—two years later [editorial]. J Med Libr Assoc. 2002 Oct;90(4):367–9.
47. Banks MA. Defining the informationist: a case study from the Frederick L. Ehrman Medical Library [comment and opinion]. J Med Libr Assoc. 2006 Jan;94(1):5–7.
48. Plutchak TS. Informationists and librarians [editorial]. Bull Med Libr Assoc. 2000 Oct;88(4):391–2.
49. Brown HA. Clinical medical librarian to clinical informationist. Ref Serv Rev. 2004;32(1):45–9.
50. Detlefsen EG. The education of informationists, from the perspective of a library and information sciences educator. J Med Libr Assoc. 2002 Jan;90(1):59–67.
51. Shipman J, Homan M. Medicine's library lifeline. Libr J. 2003;128(6):49–50.
52. Badgett R, Mulrow C. Using information technology to transfer knowledge: a medical institution steps up to the plate. Ann Intern Med. 2005 Feb 1;142(3):220–1.
53. Byrd GD. Can the profession of pharmacy serve as a model for health informationist professionals? J Med Libr Assoc. 2002 Jan;90(1):68–75.
54. Detlefsen EG. Clinical research informationist. Ref Serv Rev. 2004;32(1):26–30.
55. Geer RC. Broad issues to consider for library involvement in bioinformatics. J Med Libr Assoc. 2006 Jul;94(3):286–98, E152–5.
56. Homan JM, McGowan JJ. The Medical Library Association: promoting new roles for health information professionals. J Med Libr Assoc. 2002 Jan;90(1):80–5.
57. Jerome RN, Giuse NB, Gish KW, Sathe NA, Dietrich MS. Information needs of clinical teams: analysis of questions received by the Clinical Informatics Consult Service. Bull Med Libr Assoc. 2001 Apr;89(2):177–84.
58. Adams A, Blandford A, Attfield S. Implementing digital resources for clinicians' and patients' varying needs. Med Inform Internet Med. 2005 Jun;30(2):107–22.
59. Klem ML, Weiss PM. Evidence-based resources and the role of librarians in developing evidence-based practice curricula. J Prof Nurs. 2005 Nov–Dec;21(6):380–7.
60. Lyon JA, Tennant MR, Messner KR, Osterbur DL. Carving a niche: establishing bioinformatics collaborations. J Med Libr Assoc. 2006 Jul;94(3):330–5.
61. Minie M, Bowers S, Tarczy-Hornoch P, Roberts E, James RA, Rambo N, Fuller S. The University of Washington Health Sciences Library BioCommons: an evolving Northwest biomedical research information support infrastructure. J Med Libr Assoc. 2006 Jul;94(3):321–9.
62. Rein DC. Developing library bioinformatics services in context: the Purdue University Libraries bioinformationist program. J Med Libr Assoc. 2006 Jul;94(3):314–20,E193–7.
63. Shearer BS, Seymour A, Capitani C. Bringing the best of medical librarianship to the patient team. J Med Libr Assoc. 2002 Jan;90(1):22–31.
64. Zeiger RF. Toward continuous medical education. J Gen Intern Med. 2005 Jan;20(1):91–4.
65. Zipperer L. Clinicians, librarians and patient safety: opportunities for partnership. Qual Saf Health Care. 2004 Jun;13(3):218–22.

66. Wade CA, Turner HM, Rothstein HR, Lavenberg JG. Information retrieval and the role of the. information specialist in producing high-quality systematic reviews in the social, behavioural and education sciences. Evid Policy. 2006 Jan;29(1):89–108.
67. Beverley CA, Booth A, Bath PA. The role of the information specialist in the systematic review process: a health information case study. Health Info Libr J. 2003 Jun;20(2):65–74.
68. Helms AJ, Bradford KD, Warren NJ, Schwartz DG. Bioinformatics opportunities for health sciences librarians and information professionals. J Med Libr Assoc. 2004 Oct;92(4):489–93.
69. Institute of Medicine. Crossing the quality chasm: a new health system for the 21st century. Washington, DC: National Academies Press; 2001.
70. Florance V, Giuse NB, Ketchell DS. Information in context: integrating information specialists into practice settings. J Med Libr Assoc. 2002 Jan;90(1):49–58.
71. Watson EM. Subject knowledge in the health sciences library: an online survey of Canadian academic health sciences librarians. J Med Libr Assoc. 2005 Oct;93(4):459–66.
72. Swinglehurst DA, Pierce M. Questioning in general practice: a tool for change. Br J Gen Pract. 2000 Sep;50(458):747–50.
73. McClure LW. A rose is a rose [comment and opinion]. J Med Libr Assoc. 2003 Apr;91(2):144–6.
74. Whitmore SC, Grefsheim SF, Rankin JA. Informationist program in support of biomedical research. Health Info Libr J. 2008 Jun;25(20):135–41.
75. Dalrymple PW. The impact of medical informatics on librarianship. IFLA J. 2002;28(5/6):312–7.
76. Hersh W. Medical informatics education: an alternative pathway for training informationists. J Med Libr Assoc. 2002 Jan;90(1):76–9.
77. Martin P, Kauser A. An informaticist working in primary care: a descriptive study. Health Informatics J. 2001 Jun;7(2):66–70.
78. Campbell JM, Roderer NK. Fellowship training at Johns Hopkins: programs leading to careers in librarianship and informatics as informaticians or informationists. Med Ref Serv Q. 2005 Spring;24(1):93–9.
79. MacMullen WJ, Vaughan KTL, Moore ME. Planning bioinformatics education and information services in an academic health sciences library. Coll Res Libr. 2004 Jul;65(4):320–33.
80. Traditi LK, Le Ber JM, Beattie M, Meadows SE. From both sides now: librarians' experiences at the Rocky Mountain Evidence-Based Health Care Workshop. J Med Libr Assoc. 2004 Jan;92(1):72–7.
81. Lyon J. Beyond the literature: bioinformatics training for medical librarians. Med Ref Serv Q. 2003 Spring;22(1):67–74.
82. Lyon J, Giuse NB, Williams A, Koonce T, Walden R. A model for training the new bioinformationist. J Med Libr Assoc. 2004 Apr;92(2):188–95.
83. Berwick DM. The John Eisenberg lecture: health services research as a citizen in improvement. Health Serv Res. 2005 Apr;40(2):317–36.
84. Deshpande N, Publicover M, Gee H, Khan KS. Incorporating the views of obstetric clinicians in implementing evidence-supported labour and delivery suite ward rounds: a case study. Health Info Libr J. 2003 Jun;20(2):86–94.
85. Moros Ghersi CA. Clinical focus and patient management in the XXI century within the context of the advances in medicine. In: Vargas Arenas RE, Oletta JF, Velasco M, eds. Current trends in clinical medicine: selected proceedings of the XIth scientific meeting of the Hospital Vargas; Caracas, Venezuela; 21–25 Nov 2000. Amsterdam, The Netherlands: Elsevier; 2002. p. 35–43. (International Congress series 1237).
86. Sherwill-Navarro P. Nursing librarian: an educator of future nurses. Ref Serv Rev. 2004;32(1):40–4.
87. Sathe NA, Lee P, Giuse NB. A power information user (PIU) model to promote information integration in Tennessee's public health community. J Med Libr Assoc. 2004 Oct;92(4):459–64.
88. Brookman A, Lovell A, Henwood F, Lehmann J. What do clinicians want from us? an evaluation of Brighton and Sussex University Hospitals NHS Trust clinical librarian service and its implications for developing future working patterns. Health Info Libr J. 2006 Dec;23(suppl 1):10–21.
89. Tennant MR. Bioinformatics librarian: meeting the information needs of genetics and bioinformatics researchers. Ref Serv Rev. 2005;33(1):12–9.
90. Schacher LF. Clinical librarianship: its value in medical care. Ann Intern Med. 2001 Apr 17;134(8):717–20.
91. Burdick A. Informationist? internal medicine rounds with a clinical librarian. J Hosp Libr. 2004 Mar;4(1):17–27.
92. Holden G, Rosenberg G. The deep web, dark matter, metabundles and the broadband elites: do you need an informaticist? Soc Work Health Care. 2003 May;36(4):1–18.
93. Scherrer CS. Reference librarians' perceptions of the issues they face as academic health information professionals. J Med Libr Assoc. 2004 Apr;92(2):226–32.
94. Sladek RM, Pinnock C, Phillips PA. The informationist in Australia: a feasibility study. Health Info Libr J. 2004 Jun;21(2):94–101.
95. Wales A. Managing knowledge to support the patient journey in NHS Scotland: strategic vision and practical reality. Health Info Libr J. 2005 Jun;22(2):83–95.
96. Sathe NA, Jerome R, Giuse NB. Librarian-perceived barriers to the implementation of the informationist/information specialist in context role. J Med Libr Assoc. 2007 Jul;95(3):270–4.
97. Guessferd M. The clinical librarian/informationist: past, present, future. J Hosp Libr. 2006 Jul 17;6(2):65–73.
98. Ward L. A survey of UK clinical librarianship: February 2004. Health Info Libr J. 2005 Mar;22:26–34.
99. Adams A, Blandford A, Lunt P. Social empowerment and exclusion: a case study on digital libraries. ACM Trans Comput-Hum Interact. 2005 Jun;12(2):174–200.
100. Verhoeven AA, Schuling J. Effect of an evidence-based answering service on GPs and their patients: a pilot study. Health Info Libr J. 2004 Sep;21(suppl 2):27–35.
101. Institute of Medicine. Health professions education: a bridge to quality. Washington, DC: National Academies Press; 2003.
102. Wolf DG, Chastain-Warheit CC, Easterby-Gannett S, Chayes MC, Long BA. Hospital librarianship in the United States: at the crossroads. J Med Libr Assoc. 2002 Jan;90(1):38–48.
103. Burstin H, Clancy C. Nontraditional approaches to primary care delivery. In: Showstack J, Rothman AA, Hasmiller S, eds. The future of primary care. San Francisco, CA: Jossey-Bass; 2004. p. 89–107.
104. Houghton B, Rich EC. The informationist. Ann Intern Med. 2001 Feb 6;134(3):251–2.
105. Howse DK, Bracke PJ, Keim SM. Technology mediator: a new role for the reference librarian? Biomed Digit Libr. 2006 Oct 13;3:10.
106. Root Jorgensen DB. The informationist. Ann Intern Med. 2001 Feb 6;134(3):251.
107. Sandroni S. The informationist. Ann Intern Med. 2001 Feb 6;134(3):251.
108. Arnott Smith C. An evolution of experts: MEDLINE in the library school. J Med Libr Assoc. 2005 Jan;93(1):53–60.

109. Sladek RM, Pinnock C, Phillips PA. The informationist: a prospective uncontrolled study. Int J Qual Health Care. 2004 Dec;16(6):509–15.
110. Rosenbloom ST, Giuse NB, Jerome RN, Blackford JU. Providing evidence-based answers to complex clinical questions: evaluating the consistency of article selection. Acad Med. 2005 Jan;80(1):109–14.
111. Chattopadhyay A, Tannery NH, Silverman DA, Bergen P, Epstein BA. Design and implementation of a library-based information service in molecular biology and genetics at the University of Pittsburgh. J Med Libr Assoc. 2006 Jul;94(3):307–13,E192.
112. Ash JS, Gorman PN, Lavelle M, Lyman J, Delcambre LM, Maier D, Bowers S, Weaver M. Bundles: meeting clinical information needs. Bull Med Libr Assoc. 2001 Jul;89(3):294–6.
113. Cataldo TT, Tennant MR, Sherwill-Navarro P, Jesano R. Subject specialization in a liaison librarian program. J Med Libr Assoc. 2006 Oct;94(4):446–8.
114. Urquhart C, Spink S, Thomas R, Durbin J. Systematic assessment of the training needs of health library staff. Libr Inf Res. 2005 Winter;29(93):35–42.
115. De Simone J. The ECHO project: (50th) proposal for IQCPOP. Med Gen Med. 2004 Mar 16;6(1):13.
116. Blake C, Pratt W. Collaborative information synthesis II: recommendations for information systems to support synthesis activities. J Am Soc Inf Sci Tech. 2006 Dec;57(14): 1888–95.
117. Gurses AP, Xiao Y. A systematic review of the literature on multidisciplinary rounds to design information technology. J Am Med Inform Assoc. 2006 May–Jun;13(3):267–76.
118. Hersh W, Miller R, Olson D, Sacherek L, Cross P. Professional's Information Link (PiL): a web-based asynchronous consultation service. Proc AMIA Symp. 2002: 325–9.
119. Schwartz A, Millam G. A web-based library consult service for evidence-based medicine: technical development. BMC Med Inform Decis Mak. 2006 Mar 16;6:article no. 16.
120. Houston TK. Clinical questions: new research on barriers and solutions to finding information. Johns Hopkins Adv Stud Med. 2005 Mar;5(3):153–4.
121. Dalrymple PW. Improving health care through information: research challenges for health science librarians. Libr Trends. 2003 Spring;51(4):525–40.
122. Thornton-Jones H, Hampshaw S, Taylor A. Informaticist services for policymakers will differ from those studied. BMJ. 2002 Jun 15;324(7351):1456.
123. Schroeder R, Van de Ven A, Scudder G, Polley D. Managing innovation and change processes: findings from the Minnesota Innovation Research Program. Agribusiness. 1986 Winter;2(4):501–23. (Available from: <http://webpages.csom.umn.edu/smo/avandeven/MIRP/Schroederetal86.pdf>. [cited 31 Oct 2007].)
124. Rook R, Adsheadt F. Postgraduate training in public health medicine: St. George's Hospital Medical School public health information service. Health Info Libr J. 2001 Mar;18:38–44.
125. Oliver KB, Roderer NK. Working towards the informationist. Health Informatics J. 2006 Mar;12(1):41–8.
126. Lappa E. Undertaking an information-needs analysis of the emergency-care physician to inform the role of the clinical librarian: a Greek perspective. Health Info Libr J. 2005 Jun;22(2):124–32.
127. Magyary D, Whitney JD, Brown MA. Advancing practice inquiry: research foundations of the practice doctorate in nursing. Nurs Outlook. 2006 May–Jun;54(3):139–51.
128. Martín-Calero MJ, Machuca M, Murillo MD, Cansino J, Gastelurrutia MA, Faus MJ. Structural process and implementation programs of pharmaceutical care in different countries. Curr Pharm Des. 2004;10(31):3969–85.
129. Parker-Oliver D, Demiris G. Social work informatics: a new specialty. Soc Work. 2006 Apr;51(2):127–34.
130. Schott MJ. The informationist. Ann Intern Med. 2001 Feb 6;134(3):252–3.

AUTHORS' AFFILIATIONS

Jocelyn A. Rankin, PhD, MLn, AHIP, FMLA, jrankin@cdc.gov, Chief; CDC Information Center, Centers for Disease Control and Prevention, 1600 Clifton Road, Mailstop C04, Atlanta, GA 30333; **Suzanne F. Grefsheim, MEd, MSLS, FMLA,** grefshes@nih.gov; Director; **Candace C. Canto, MA, MLS,** cantoc@nih.gov, Special Assistant to the Director; Division of Library Services, National Institutes of Health, 10 Center Drive, MSC–1150, Bethesda, MD 20892

Received September 2007; accepted December 2007